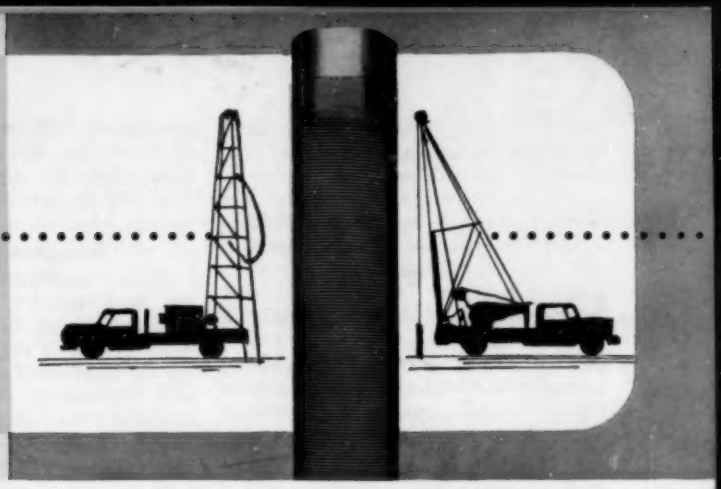
The Johnson National DRILLERS JOURNAL



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ROTARY DRILLING

Setting Screens and Developing

OUR previous article on rotary drilling described the function of the drilling fluid in detail. We went to some length to explain how the mud cake forms on the wall of the drilled hole and how the properties of the drilling fluid affect its formation.

We started a discussion about mud invasion of the water-bearing formation; that is, the extent of movement of the drilling fluid outward through the pores of the sand. It was pointed out that, in drilling a water well by the rotary method, an appreciable quantity of the drilling fluid flows out radially through the wall of the hole and clogs the pores of the formation for some distance in all directions.

In this article, we shall continue the discussion of mud invasion of the water-bearing sand and take up the problem of removing this drilling mud in the development of the well.

An important property of the mud in this connection is its tendency to "set," or develop "gel strength," as its rate of flow slows down. When the drilling fluid is flowing at a good speed, it acts like any liquid. However, when it comes to rest or is moving quite slowly, it thickens appreciably by becoming somewhat jelly-like. We say that it develops "gel strength" under these conditions because it takes some extra push, such as higher pump pressure, to start the mud flowing again.

The degree to which the mud thickens or congeals when it is at rest varies with the type of clay in the fluid. Bentonite clay makes a mud that develops greatest gel strength. Ball clay produces a fluid with considerably less gel strength. Fluids made with most native clays also have low gel strength. The dissolved minerals in the water portion also affect the gel properties of the drilling mud.

By adding certain chemicals to the fluid, the gel strength can be varied. Addition of a little lime or cement, for example, will thicken the mud. On the other hand, some of the polyphosphates that are widely used in detergents will reduce both the viscosity and gel strength. As a result of this property, these phosphates can be used when developing a well to help remove the mud that has invaded the water-bearing formation in the progress of drilling.

To make a fluid of a given viscosity or fluidity requires at least twice as much ball clay as it does bentonite. Having less gel strength, a drilling fluid

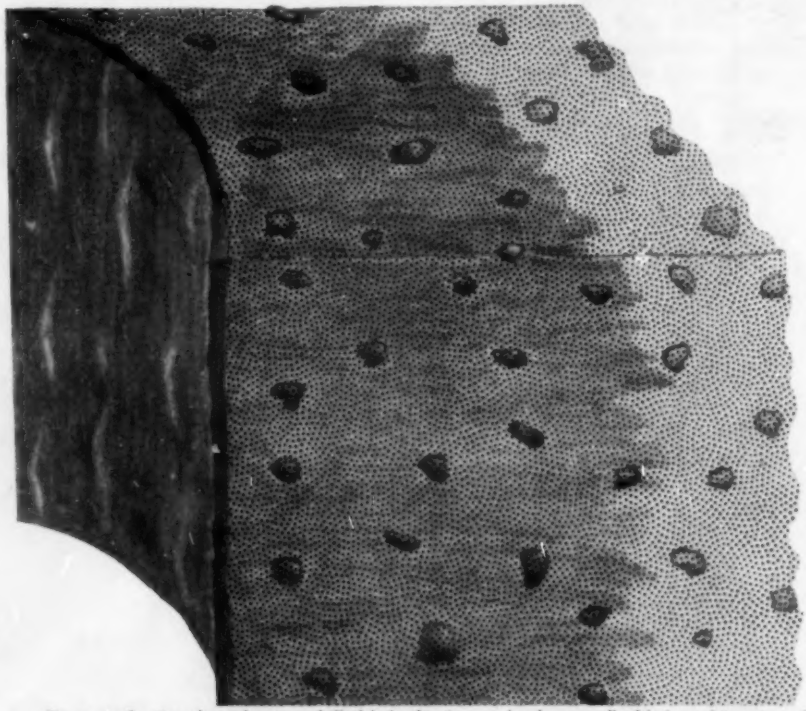

Figure 1. Section through rotary-drilled hole showing mud cake on wall of hole and invasion of sand formation by drilling mud. Mud flows outward until the pores of the formation are clogged. Once effective clogging occurs, outward flow ceases and the wall cake forms in the drilled hole.

made with ball clay is easier to remove from the formation immediately surrounding the drill hole, but it also invades the formation to a greater distance. Considerations of the difference in gel strength seem to indicate that ball-clay drilling fluid is desirable when working in fine-sand formations of fairly low permeability, whereas bentonite is more desirable for drilling in formations of higher permeability. Adding bentonite to a mud made with any other type of clay will increase the gel strength of the fluid as required.

Figure 1 has been prepared to show what happens while drilling through a clean, permeable, water-bearing sand. It represents a block cut out of the formation on one side of the hole. The hydrostatic pressure of the drilling fluid in the hole forces some of the fluid out through the voids in the sand. The fluid moves out radially in all directions. As it flows outward its rate of movement through the pores in the sand becomes less and less since it is spreading in a circular fashion (Figure 2).

In drilling a 12-inch hole, for example, its rate of movement may be reduced by one-half at a distance of two or three inches outside the wall of the hole. At some critical distance from the hole, where the flow rate is reduced sufficiently, the mud thickens in the pores of the sand and develops gel strength. This increases the resistance to flow and stops further mud invasion.

The critical distance at which the mud invasion stops is different for each situation. It will vary with the viscosity of the drilling fluid, the fluid pressure in the hole, the gel properties of the fluid and the permeability of the water-bearing sand.

Removing the Mud

Having examined in detail the way the mud invades a sand formation around a rotary-drilled hole, we now want to look at the problem of removing the mud during development of the well. Obviously, all the mud must be removed if the well is to develop the full yield of the formation.

In discussing the development work here, we are assuming that the well screen has been installed in the well by one of the methods described in the last half of this article.

Normal means of development are employed and are supplemented by some special measures to insure removal of the drilling mud. Surging is done with surge plungers, with compressed air or by backwashing. Most of the mud moves into the well along with the fine sand that is brought through the screen openings by the development work. However, it is possible to develop a well to a sand-free condition and still leave some of the drilling mud in the formation.

Figure 3 shows how some of the sand can remain clogged with the mud as the well is surged. During the initial stages of development the mud is pulled in from those areas or zones where the surging action agitates it most easily. However, the mud clogs some zones more tightly than others due to differences in the permeability of the sand at various points and differences in the gel strength of the mud at various places in the invaded zone.

In some spots the mud is so tightly set in the pores that the surging forces are not sufficient to break the gel and start it moving. Under the action of the surge, the water moves in and out more freely through the developed portions of the formation. Since the water moves in the paths of least resistance, it is easy to see how it will continue surging back and forth through those areas where the mud has already been washed out and the permeability most improved. Under such conditions, the water will have little tendency to break down the mud remaining in the more tightly clogged portions.

Several steps can be taken to supplement normal development procedure to help remove the last bits of drilling mud from the formation. First of all, it is important to circulate clean water to displace all the drilling fluid from the hole as soon as the screen is set. This should be started even before the casing is pulled back to expose the screen — assuming that the telescope method of setting the screen is employed.

Second, it is helpful to pull the casing and expose the screen in stages, developing the well by surging and backwashing each time the casing is lifted. For example, the casing may be pulled four or five feet and held in this position while the well is surged and bailed or

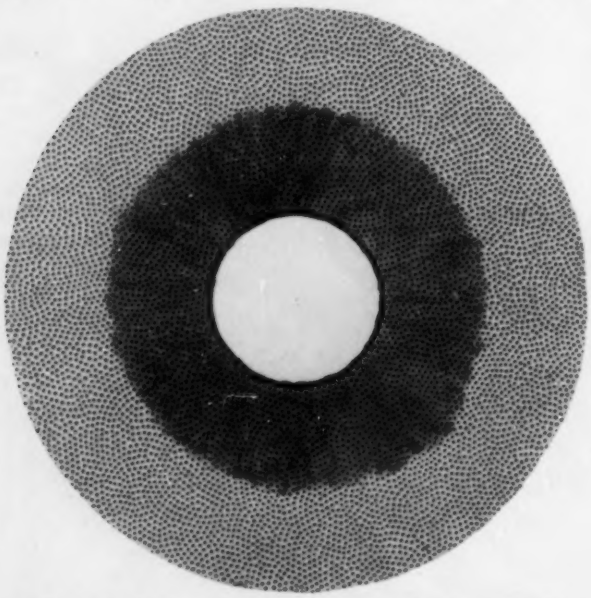

Figure 2. Drilling mud invades the water-bearing sand while drilling is in progress and must be removed from the formation by development when completing the well.

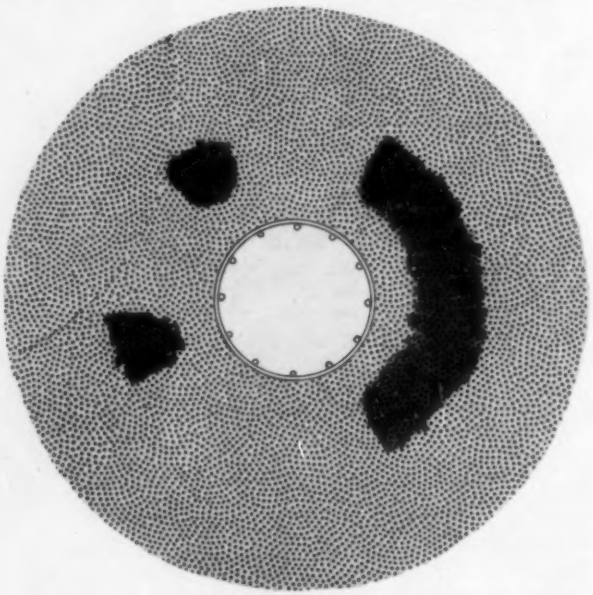

Figure 3. When the well screen is in place, the drilling mud is removed by surging and backwashing. Some mud may remain if this work is not properly done.

developed with compressed air. This concentrates the development first in the lower few feet of the formation; and the resulting more vigorous movement of water does a better job of cleaning the mud out of the sand. This sequence of operations is repeated until the entire screen is exposed.

Third, using plenty of clean water for backwashing whenever possible during the development procedure is always helpful. When backwashing, the water should be introduced in the screen through a string of pipe and at as high velocity as practicable in order to cause turbulence.

Fourth, adding a small proportion of one of several polyphosphates to the water that is circulated to displace the drilling fluid, to the water used for backwashing and to the water standing in the well helps considerably in mud removal. These phosphates disperse the clay in the drilling mud and reduce its gel strength.

The dispersing action counteracts the tendency of the mud to stick to the sand grains. Breaking the gel strength makes the mud more easily moved by surging and backwashing. The phosphates that work effectively in helping mud removal are:

(1) Tetra sodium pyrophosphate
(2) Sodium tripolyphosphate
(3) Sodium hexametaphosphate
(4) Sodium septaphosphate

About five pounds of the chemical to each 100 gallons of water should be used. A larger amount of phosphate does not give markedly different results than this quantity.

Experience on a job that recently came to our attention shows how some of the drilling mud can be left in the formation, as illustrated in Figure 3, even though the well may appear to be completely developed.

In this case, an eight-inch well was drilled by the rotary method for a creamery in central Minnesota. The well is 171 feet deep and penetrates 15 feet of coarse, water-bearing sand. The static level is 32 feet. A Johnson Everdur well screen, 15 feet long with No. 75 slot openings was installed. As soon as the screen was set, clean water was circulated to displace all the drilling fluid from inside the casing and screen. The well was then surged by the use of compressed air and was pumped out by air-lift until it was sand-free. The well cleared up after a few hours of development work to the extent that no cloudiness or turbidity could be detected in the water.

The drilling contractor then decided to experiment a little to see if he had actually removed all the drilling mud. He prepared a solution of 30 pounds of tetra sodium pyrophosphate in a 55-gallon barrel of water, which he then put into the well through the string of pipe being used as the air line. He resumed surging with compressed air and in a short time the well was full of muddy water.

This showed clearly that some drilling mud had been left in the water-bearing sand when the well had cleared up the first time. Additional pumping after the polyphosphate treatment cleared the well again and it was tested at a sustained rate of 300 gpm. Actually, this well is capable of delivering twice this yield.

Installing Well Screen

Assuming that a naturally-developed well is being constructed, the best method for installing the screen is to run the casing to the bottom of the hole, clean out inside the casing, lower the screen to bottom, and then pull the casing back to expose the screen.

When it is not practicable to use the pull-back method, the screen may be set by the steps illustrated in Figure 4. The hole is drilled to the full depth of the well. Samples of the formation, for use in determining the proper screen openings, may be taken while drilling the full-size hole or they may be taken from a smaller hole that is first drilled and then reamed to the diameter required for completing the well. The screen may be fitted with a closed bail bottom or with an open bottom and short extension pipe so that it can be washed down through any cuttings that may have settled in the bottom of the hole.

The well screen is lowered to the bottom of the well by any convenient means. If an open bottom screen is used, the bottom is then plugged with lead wool or cement grout. The lead packer top is then expanded inside the well casing.

A variation of this procedure is to

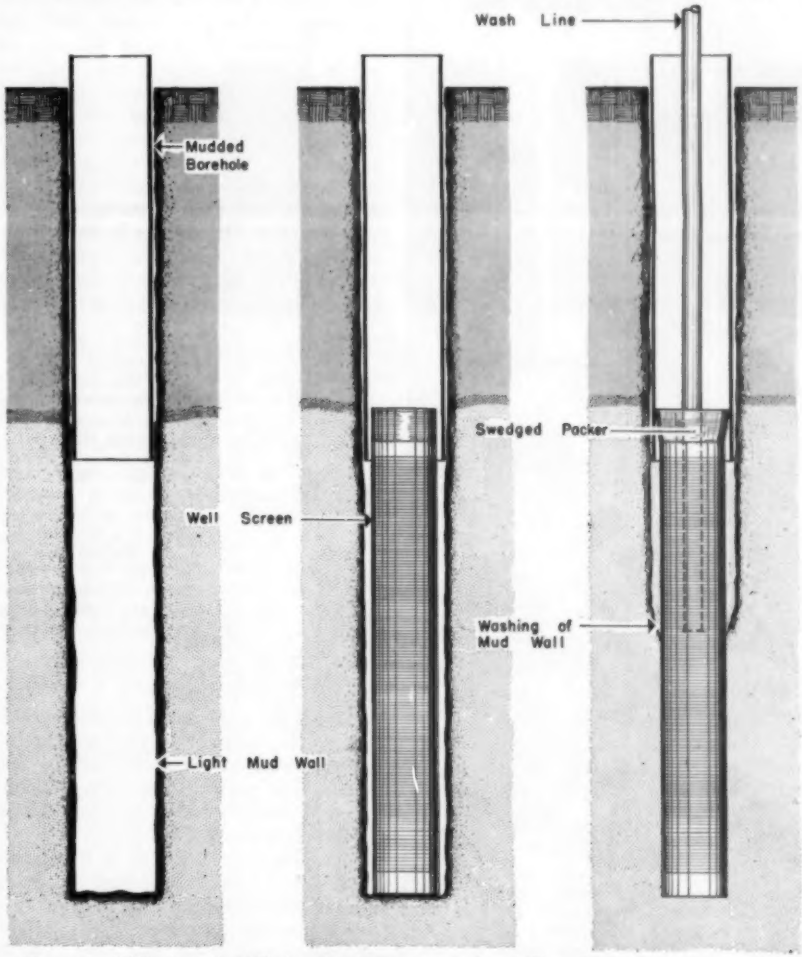

Figure 4. With the hole drilled and held open by the drilling fluid, the casing and well screen may be set as shown here. An even better procedure is to set the casing to the full depth of the well, lower the screen inside it, then pull the casing back to expose the screen.

first drill the hole to the proper depth to set the casing in its permanent position. The casing may then be cemented or otherwise sealed in place before installing the screen. A slightly smaller bit is then employed to drill the hole below the casing to receive the well screen.

When the screen is in place, the drilling fluid should be washed out of the well progressively by circulating clean water. Compressed air can be used to accomplish the same result if properly handled.

If air is used, the air line should be lowered to the bottom of the well. Two or three hundred gallons of water with 15 to 20 pounds of polyphosphate should be put into the well through this pipe. After connecting to the compressor, air should be admitted very slowly at first to cause some agitation in the screen.

The purpose of this is to partially clean up one or two feet of the formation so that some will come into the lower part of the well, replacing the drilling mud, as the air-lift causes the fluid to flow upward through the casing. The air should be cut off from time to time and the fluid level in the well checked.

If the fluid does not drop below the normal static water level, additional air may be used. However, if the fluid drops below the static water level, water is not coming into the well and the wall of the hole around the screen is still sealed. More clean water must then be put in through the air line. If a large volume of air is shot into the well with the screen openings and sand formation still sealed, the whole column of drilling fluid in the casing can be suddenly lifted by the compressed air. The result will be to subject the well screen to a severe collapsing pressure.

Before admitting any large quantities of air to the well, therefore, it is most important that a small section of the screen be free and open. The work should be done in a manner that will permit the formation sand to close in uniformly around the screen. Severe shifting of the formation on one side of the hole can take place if proper methods are not used.

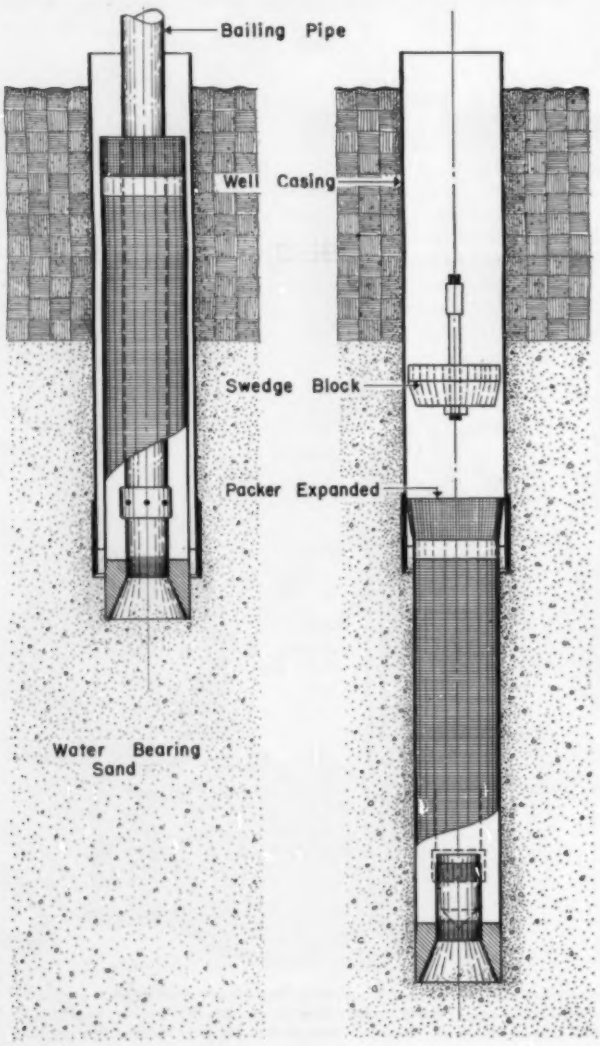

Figure 5. The bail-down method for installing the well screen is employed when it is desired to avoid drilling through the water-bearing sand in which the screen is to be set. The casing is set and cemented or otherwise sealed in a hole drilled to the desired depth. The screen is then telescoped through the casing and bailed down into the formation below.

Bail-Down Method

Conditions sometimes make it desirable to set a well screen by bailing it down through the water-bearing sand. In this case, the hole is first drilled to the proper depth to set the casing in its permanent position. The casing is then sealed or grouted in place. If cement grout is used, the plug is drilled out of the lower part of the casing when the cement has hardened.

The well screen, fitted with a bail-down shoe, is lowered through the casing in telescope fashion. The screen is suspended on a string of pipe which is connected to the bail-down shoe by means of special connecting fittings as shown in Figure 5. The whole assembly is sunk into the formation below the well casing by operating the bailer and other tools through the string of pipe (called the bailing pipe).

Frequently, a small diameter hole is drilled through the formation after setting the casing and before installing the screen in order to get samples of the water-bearing sand and check for boulders or other obstructions. This operation is done as quickly as possible to minimize mud invasion of the sand. Upon completing the drilling, the drilling fluid should be washed out or bailed out of the casing before lowering the screen.

When the screen has been bailed down to the desired depth, a weighted wood plug is dropped through the bailing pipe to seat in the special nipple above the bail-down shoe. The entire string of bailing pipe is then disconnected by turning it to the right several turns to unscrew the lefthand joint at the top of the nipple. Upon removing the bailing pipe, the lead packer is expanded with a swedging tool and the well is ready for development.

Wash-Down Method

Figure 6 shows the essential details of the wash-down method of installing a well screen. The casing is first set to the desired depth as described for the bail-down method. In Figure 6 it is shown cemented or grouted in the previously drilled hole, the cement plug in the casing being drilled out after the grout has set.

With the casing in place, a small diameter hole can be drilled through the

formation below to get samples or simply for exploration as described above.

The screen is fitted with a self-closing bottom into which is connected a string of pipe (usually drill pipe) to be used as the wash line. The screen is lowered

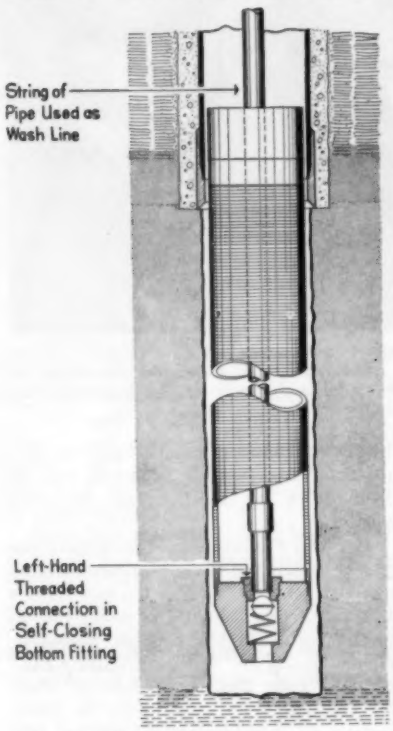

Figure 6. The wash-down method for installing the well screen works well in formations of fairly uniform sand without heavy gravel. This diagram shows the casing cemented in place before installing the screen.

through the casing and light-weight drilling mud is pumped through the wash line. A fairly high pump pressure is needed to produce a high-velocity jet of fluid through the self-closing bottom. The jetting action loosens the sand and allows the screen to sink. The sand is brought up around the screen and comes up inside the casing with the return flow of the fluid.

Some of the larger particles inevitably drop back inside the screen since the upward velocity of the fluid decreases suddenly just above the lead packer. By the time the screen is in final position it is almost sure to be partially filled with sand.

When the screen is on bottom, clean water should be pumped through the wash line and circulation continued at a somewhat reduced rate to remove any wall cake that may have formed during the jetting operation. It is essential that the formation sand cave around the screen and grip it so the wash line can be unscrewed. As soon as the screen is tight, the wash line is disconnected by turning it to the right.

With the screen partly full of sand, it is probable that the wash line cannot be pulled out because of sand-locking. Pumping some water through the pipe after raising it a few inches will loosen the sand inside the screen and free the pipe.

Artificial Gravel Treatment

In a gravel-packed well, the well screen is usually installed by the open-hole method as illustrated in Figure 7. The outer casing is set to the required depth and suspended in position with clamps or slips at the ground surface. The inner casing is then run to the bottom of the well. Suitable guides are welded to this pipe to keep it centered in the outer casing and in the open hole below.

The next step is to telescope the screen through the inner casing. The properly selected gravel treatment is then fed into the annular space around the inner casing. This casing is lifted in stages as the gravel-pack material is placed, keeping the lower three or four feet of the pipe in the gravel at all times.

When the full length of the screen surface is exposed, the casing is held in position and enough gravel is added to fill in several feet above the screen. The drilling fluid can then be displaced from the well by circulating clean water and development work can be started to clean the drilling mud out of the gravel-treatment and out of the water-bearing sand.

Considerably more backwashing is required for removing the mud from a gravel-packed well than from a naturally-developed well. Note from Figure 7 that the wall cake in a gravel-packed well is sandwiched between the gravel treatment and the water-bearing sand. It is difficult to produce enough agitation by surging alone to break down the mud cake under these conditions. Alternating operations of surging and backwashing are required, together with liberal use of a polyphosphate to help disperse the clay.

Summary

The detailed discussion of the basic working principles of rotary drilling in our previous articles and the analysis here of methods of setting well screens and developing wells to insure complete removal of the drilling fluid show how important it is to keep constantly in mind the interdependence of all the operations. A clear understanding of the fundamentals of drilling, screening and development is a basic requirement in properly completing water wells drilled by the rotary method.

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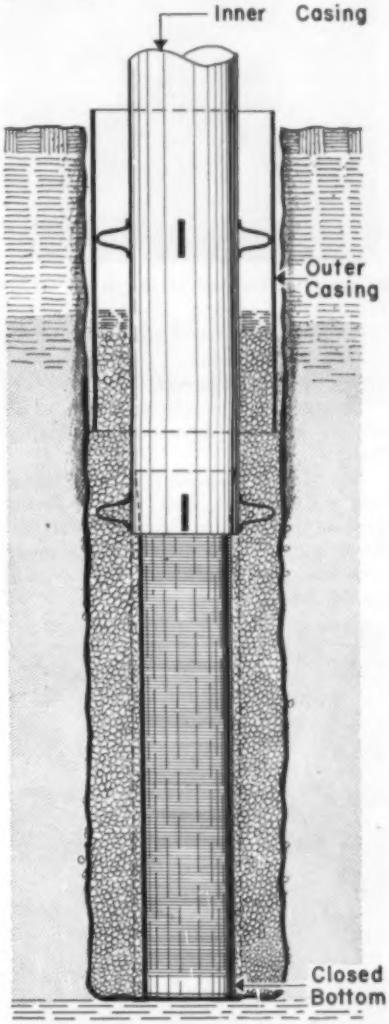


Figure 7. Gravel-packing is done by first setting the inner casing to the bottom of the hole, lowering the screen to bottom through this casing and pulling the pipe back to expose the screen as the gravel treatment is fed into the annular space. Centering devices attached to the pipe to keep it centered in the hole insure a uniform thickness of gravel.

Our Apologies

A short article in the January-February issue of the *Journal* urged water-well drillers to provide "hard hats" for every man working around a drilling machine.

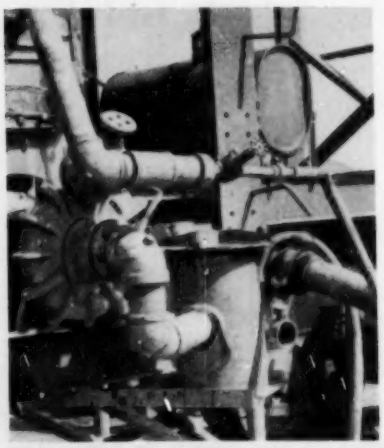
In listing the manufacturers of these protective hats, we failed to give the name of the outstanding Northwest distributor of safety equipment who gave

us material for use in the article. This company is:

Continental Safety Equipment, Inc.,
1551 Selby Avenue,
St. Paul 4E, Minnesota.

This firm can supply the needs of all drillers in this region of the United States.

We offer our apology to Continental Safety Equipment, Inc., for not listing them as a supplier in the original article. We thank them for their cooperation in furnishing the picture and some material for the article.



Centrifugal pumps have been used on some rotary drilling machines for water-well work where high rate of circulation of the drilling fluid is more important than high pressure. A trash trap is placed in the suction line to protect the pump.

USGS Completes 75 Years

President Eisenhower commends the U. S. Geological Survey on the 75th anniversary of its founding. Shown here at the White House are President Eisenhower; Dr. W. E. Wrather, Director of the USGS; Felix S. Wormser, Assistant Secretary of the Interior; and Douglas McKay, Secretary of the Interior, who presented Dr. Wrather to the President on this occasion.

In March of this year the United States Geological Survey completed the 75th year of its service to the nation, having been established on March 3, 1879. During its career, the USGS has been charged with responsibility for the scientific discovery, evaluation and conservation of minerals, land and water resources. Topographic mapping of the United States, its territories and possessions is another of its primary jobs.

The Water Resources Division of the USGS, although somewhat younger than other branches, has come to be a most important arm of the Survey. It has two major sections, one dealing with surface water investigations, the other dealing with ground water studies.

This Division supplies basic information on the occurrence, availability and quality of the water in our lakes, streams and ground water aquifers. It prepares and distributes hundreds of reports each year containing fundamental data needed in developing sound policies for the use and conservation of our valuable water resources. It is giving increasing attention to studying the quantitative and qualitative water requirements of industry.

Dr. William E. Wrather, present director of the USGS, has headed its work since 1943. He is recognized in engineering and scientific circles as an outstanding geologist, scientist and historian, distinguished for his service to the nation.

Director Wrather points out that, although the United States as a whole is rich in water resources, water supply has become a major problem. Needs have increased so rapidly in some places that water shortages have appeared. Unless adequate water can be found in such places, their further progress will be held down by the amount of water available.

Carl G. Paulsen, chief hydraulic engineer, heads the Water Resources Division of the USGS. The Ground Water Branch of this Division is under the direction of a highly capable geologist, Nelson B. Sayre. Assistant chief of the Ground Water Branch is Albert M. Fiedler, an engineer well-known to many water-well contractors throughout the country.

We join with others in congratulating the United States Geological Survey on its 75th birthday and in expressing appreciation for the contributions it has made to the economic development of our country.

The "Universal Solvent"

Water is commonly called the "universal solvent." It will attack or dissolve almost anything—sometimes slowly other times rapidly. Well waters vary greatly in their nature and behavior. Some are soft, like rain water. Others are hard because they have picked up certain minerals in solution. Soft waters are apt to be corrosive; that is, they attack metals and slowly dissolve them. Hard waters often deposit part of their minerals on the well screen and in the sand around the screen. When this occurs, the minerals and scale must be removed by acid treatment.

Oddly enough, both kinds of water present a problem of corrosion for the well screen. The only practical choice, then, in selecting the material for a well screen is to use a metal that best resists corrosion.

TOM'S COLUMN

We had a job a while back that was one of them rare kinds where we learned some more lessons an' didn't take a licking doing it. It was a kind of messy deal, yet by following some good advice we came out fine. This was one of them times when th' customer was *not* right, but we let him have his own way at his own expense.

Let's just say that th' job wasn't in our home territory an' it was done fer a food processing outfit that was enlarging an' changin' things around. Among other things, they needed some more water. They had a pretty good water well field, so there wasn't any question of where to go after it.

They had two wells, both finished in a fairly fine sand. They were 12-inch wells with No. 15 slot Johnson Everdur screens, 20 foot long, in 'em. Both wells had pumps giving about 400 gpm each. Th' wells was dropping off some an' needed acid treatment, but before working on the old wells, they wanted to put in a new well to give 500 gpm.

They had drawn up a good set o' specs on th' job callin' fer a gravel-packed well 24-inch outside casing with 12-inch inside line. No use going into th' details because there wasn't anything unusual 'bout them. Th' chief thing was that th' driller was to guarantee 500 gpm of sand-free water with not more than 25 feet drawdown at the end of ten hours pumping.

Now, when they said "sand-free," that's what they meant. They wouldn't allow any sand—not even ten kernels in ten gallons o' water. Th' water could not be "turbid," either—had to be clear at th' pump to match a standard they set. Under th' contract, th' drilling contractor was to furnish everything but the electric power for pumping and th' gravel for the pack. They figured they could get th' gravel real cheap from a local gravel pit. That was a poor way to save money, as it turned out in the end.

There wasn't anything in these things they called fer to scare any good driller away. If th' job was done right there wouldn't need to be any sand in th' water. And if th' job wasn't messed up there wasn't any danger o' gettin' cloudy water out of th' formation where th' well was to be finished. We knew these things when we bid th' job because there was good records on th' other wells and th' test work they had done in their water field.

It was one of them nice jobs to bid on, because even though th' results they demanded sounded kind of stiff, they wasn't unreasonable, an' you had all th' straight dope you needed to go on. Their old wells proved that. About all you had to do was check them an' then compare their logs an' pumpin' tests with what th' test work has shown—done by different drillers, too. They were right on th' nose.

Anyhow, we got th' job. We put on a rotary rig, an' ran down th' 24-inch casin' to 168 feet. It was ideal drilling fer a rotary. After a few feet o' dirt fill at th' top, we went through dry sand to about 50 foot. Then we had seams o' sand an' clay th' next 80 or 90 foot that graded off into clean, fine, water-bearing sand with th' water level rising up to 37 foot from th' surface.

We took samples of th' sand an' it graded out so it would use a No. 15 slot on th' upper end an' No. 18 or 20 at th' bottom if it was a straight screened well. Th' sand was nice and uniform an' clean. It would of made such a nice straight screened job I couldn't resist th' temptation o' suggesting it to them—an' makin' some reduction in my contract price, too. But they was set on the idea of makin' this one a gravel-pack, and I dropped th' subject quick.

I gave 'em my recommendation fer th' right gravel an' screen—which I had got from th' Johnson Company. Now then here's where we bumped into our first trouble. Th' local gravel pit couldn't furnish gravel of th' size recommended to fit th' curve. Th' people we were workin' fer felt we were too fussy. They couldn't see any sense to shipping in gravel at a good bit more money — mostly fer trucking charges — from 200 or more miles away. I showed 'em how much coarser th' local gravel was than what was recommended, but th' boss said just to put in enough and it would be o.k.

To protect ourselves, we gave them a written report of our work up to date

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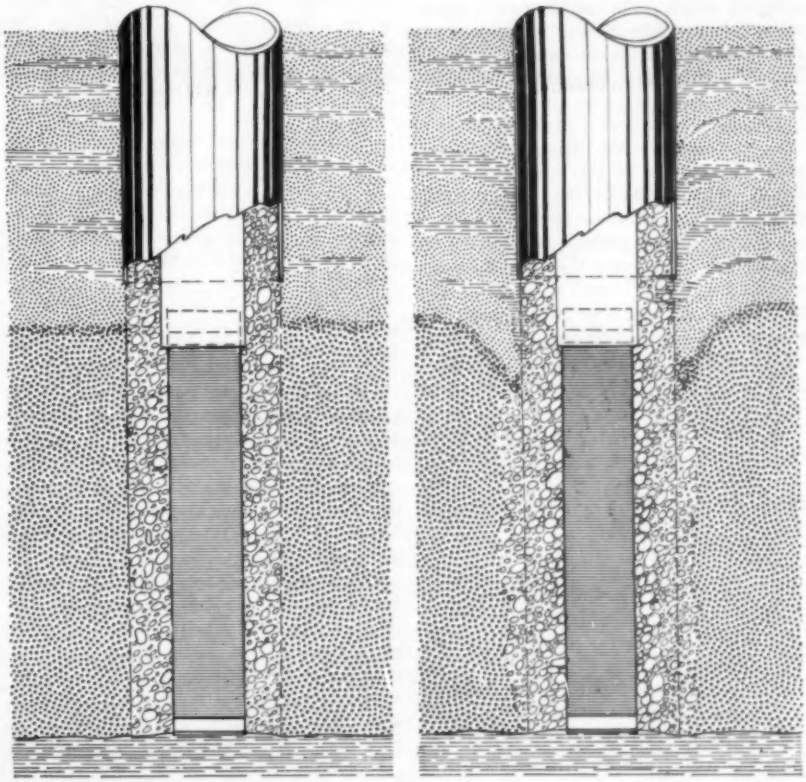

These diagrams illustrate the experience described by Tom. The one on the left shows the well with gravel treatment in place before sinking. The one on the right shows the settlement of upper fine sand and clay when the coarse gravel treatment allowed too much of the lower sand to move through into the well. Once the fine sand had settled down to the position shown, there was no way to stop it from feeding through the gravel treatment into the well.

KNOW CONDITION OF YOUR BUSINESS

Make Cost Records Work for You

By NORM OVROM

Do you really know the condition of your business? Have you given it the same kind of analysis that you would want to give a business you were considering buying from somebody else? Do you have the figures and facts available to make such an analysis?

If you can honestly answer, "Yes," to these questions you are in a happier position than most well drillers are probably in. If you can't say, "Yes," then maybe you can get some helpful suggestions from this article. Frankly, this short discussion of a big subject won't tell the whole story about what your book records can mean to you if they are properly set up and maintained, but it may give you some ideas that will help you or your accountant set things up the best way for your own particular needs.

Let's start out by saying that the principal reason for using the right bookkeeping system is to enable you to know what is happening to your business from month to month and from year to year. This is much more important than just keeping records to meet Uncle Sam's requirements. Sure, if you don't satisfy him, he might make things tough for you. But many a business has gone broke (or been badly bent) with book records that satisfied every legal requirement but left the owner pretty much in the dark — unaware that his business was getting "sick" until it was too late to find a cure. Even more often the trouble lies with inadequate records which make it hard to find the cause and cure even after it is known that the business is suffering.

All right, then, it's fair to ask what the questions are that a good set of business books should be able to answer. Here are some of the most important questions in most cases:

1. Is the business sound?
2. Is it improving?
3. Are all costs included properly?
4. Are valuations correct?
5. Are costs well-budgeted or balanced?
6. What is the trend in the ratio of gross profits to sales?
7. What is the ratio between gross profit and net profit, and what is the trend?
8. What is the relation between profit and each significant item of cost? What is the trend?

If you are set up to get answers to these questions you can probably get any others you may need without much difficulty. These are "musts" in most well drilling businesses. Just a quick look at each of them will show why.

Sound business. If we are satisfied with what is left over in the form of net profit as each year rolls by, maybe we aren't very concerned about knowing whether our business is really sound by accepted standards. But sooner or later it is likely to become necessary — or at least very desirable — to know.

Maybe a depression rolls around and we need to satisfy some banker who turns a cold eye on us. Or maybe we want to sell out and we have to show prospective buyers some real facts if we're going to make a good deal. Or maybe competition pushes us harder and our profit picture doesn't look so good. Then we begin to ask ourselves what the score is.

To take the true measure of a business requires detailed records over a period of time. This means having more than some lump-sum figures at hand. It means having a properly constituted balance sheet and a profit-and-loss statement backed up by properly distributed details. *You* would want this if you were a prospective buyer of a business, so you ought to have it if you are the owner.

Business improving? This second point is more important than the first — to know if your business is going ahead or backward. It's the "physical examination" that tells if your business is sick or well or running over with good health. You may have a satisfactory balance sheet and yet be going downhill; or your balance sheet might be lousy but your business may be going up the grade in good order. Your sales may be growing and your business could be getting sicker by the month; or you might find you had a healthier set-up with less sales than previously. It's the *whole* picture that tells the story — and you can't get it without ample book records.

All costs included? Can you look your records over and make sure that all of your costs are included properly? Are you leaving out legitimate expenses that can save you taxes, for example? Don't fool yourself on depreciation and end up with worn-out or obsolete equipment that shows a value on your books. And how about accrued or prepaid items? Are you sure that your records are such that these show for or against the proper operating period and don't gang up to make one period look better or worse than it really is? Such a situation is not only incorrect, but it is also misleading.

Valuations correct? This one ties right in with what was said in the paragraph above. Are your valuations right? Is the merchandise you show worth the full amount you state in your inventory valuation? Have you devalued or written off shop-worn, obsolete or dead stock? How about your accounts receivable? Is your reserve for bad debts realistic or just hopeful? Can you show yourself or somebody else that your methods of evaluation are sound? If you can't, you're guessing about something that may be pretty important for your business.

Costs balanced? Do your records show that your costs are reasonably balanced or budgeted? Or do they follow an uncharted course without rhyme or reason? Can you put your finger on them to keep them in hand, week by week or month by month?

Ratio of profits to sales. Now we're getting into something that is like a doctor watching his patient's blood-pressure. Is the gross profit per dollar of sales holding steady or maybe moving up or down? If it's going down, then the business may be starting to blow fuses. Here's where the price-cutter finds that he may have cut his own throat right along with his prices. He figures the most important thing of all is to make a sale, forgetting that whatever he cuts off the price comes right out of the gross profit and gives him that much less room to operate in.

When records show a more than proportional drop in gross profits, it's time to do some careful studying to see if real salesmanship can save the day. Can better salesmanship put across a good job at a fair price? If it can, it is a lot less costly in most cases than chopping off gross profit by price-cutting, which is likely to start a vicious cycle that doesn't let up until everybody gets hurt.

Mr. Ovrom is an accountant and executive secretary of the Minnesota Water Well Contractors Association.

Another thing that hits gross profit, of course, is poor production methods or inefficient equipment which increase the cost of the services a driller sells. Good records should disclose not only the *fact* of reduced gross profits but also the items that are responsible so that the owner can put his finger on them and try to correct the situation.

Gross profit and net profit. Tied inseparably with the facts about gross profit are the facts about net profit — which is the owner's chief concern because that's what's left over after the costs of selling, administration, financing, etc., have been deducted. We shouldn't forget, either, that creditors — bankers and supply houses alike — have a very great interest in this figure. Is net profit following the trend in gross profit? Is the owner's share getting more or less?

Profit and cost. You can't run a well drilling business without spending money, but it isn't necessary to throw it away. A well-run business is a matter of spending and earning — income and outgo — kept in balance so there will be more income than outgo when the end of the year rolls around. There are many items of outgo and each should contribute directly or indirectly toward producing income.

Be sure that the profit does not shrink because one or more of the cost items increase beyond proper proportions. The records should show if each item is staying within proper limits. Most expense items should be treated like undependable rascals to be kept within the extreme limits of certain percentages of sales but always to be confined more closely, if possible. Many a business has made its financial and competitive position strong by careful study and supervision of item of cost.

Raises in wage rates and in prices of materials used require increasing prices charged for drilling to maintain a profit margin. The books should show how much of each sales dollar is spent for materials, labor and other production costs and for overhead costs. From such figures you can tell if prices are adequate or if operations are efficient.

Analyzing the Records

To illustrate how the various factors in a business can be analyzed to get the answers to the foregoing questions, I have worked out typical profit and loss statements and a balance sheet for a well drilling business that is operating two drilling machines. I have assumed that the owner employs two drillers, a repair man and a helper. The owner helps on some jobs, manages the business and does all the selling. Tables I and II show his total sales, details of costs and profits for 1952 and 1953. Table III shows the assets, liabilities and present worth of this business.

Tables I and II show that this business earned a net profit of 19.4 per cent in 1952 but only 9.4 per cent the next year — a decrease of over half in 1953. In dollars, net profit went down from $11,167 to $6,040 — even though the sales figures indicate more business in 1953. Let's see what the profit and loss statements show to be the reason for this serious drop in profits.

In 1953, sales were $6,499 higher than in 1952, but production costs jumped $10,307—increasing from $43,974 to $54,281. Thus, it cost $10,307 more in 1953 to produce additional sales of only $6,499. This shows clearly that this driller did not increase his prices enough in 1953 to cover increases in his costs. Percentagewise, his production costs increased from 76.3 per cent of his 1952 sales to 84.7 per cent of his 1953 sales.

From Table I we see that materials used in 1952 cost 52.6 per cent of total sales and that this figure increased to 56.5 per cent of sales in 1953. Likewise, labor costs which were 16.0 per cent of sales in 1952 mounted to 19.9 per cent of sales the next year. Failing to take

TABLE I
PROFIT AND LOSS STATEMENTS, 1952 AND 1953

	1952		1953	
	AMOUNTS	PER CENT OF SALES	AMOUNTS	PER CENT OF SALES
SALES	$57,603.00		$64,102.00	
PRODUCTION COSTS				
Cost of Materials				
Inventory, Jan. 1	$ 144.00		$ 2,952.00	
Materials purchased	33,126.00		36,765.00	
	$33,270.00		$39,717.00	
Less Inventory, Dec. 31	2,952.00		3,528.00	
Materials used	$30,318.00	52.6%	$36,189.00	56.5%
Wages	9,220.00	16.0%	12,540.00	19.6%
Depreciation	1,482.00	2.6%	1,504.00	2.3%
Freight and trucking	0.00		72.00	
Shop supplies	136.00		687.00	
Gas and oil	1,322.00		1,861.00	
Machine and truck repair	1,496.00		1,428.00	
Total Production costs	$43,974.00	76.3%	$54,281.00	84.7%
GROSS PROFITS	$13,629.00	23.7%	$ 9,821.00	15.3%
OVERHEAD COSTS				
Accounting and legal	$ 138.00		$ 216.00	
Advertising	180.00		303.00	
Business contributions	0.00		27.00	
Commissions	50.00		150.00	
Credit and bad debts	0.00		0.00	
Customer entertainment	144.00		56.00	
Employee welfare	30.00		150.00	
Heat, light, power	130.00		117.00	
Insurance	883.00		1,484.00	
Interest	168.00		368.00	
Licenses	96.00		87.00	
Miscellaneous expenses	0.00		0.00	
Office expenses	31.00		72.00	
Personal property taxes	123.00		111.00	
Real estate taxes	48.00		93.00	
Rent	0.00		0.00	
Safety supplies	0.00		11.00	
Social security taxes	127.00		216.00	
Telephone expenses	79.00		36.00	
Association and union dues	180.00		284.00	
Travel expenses	55.00		0.00	
Total overhead costs	$ 2,462.00	4.3%	$ 3,781.00	5.9%
NET PROFIT	$11,167.00	19.4%	$ 6,040.00	9.4%

TABLE II

PROFIT AND LOSS SUMMARY, 1952 AND 1953

	1952		1953	
	AMOUNT	PER CENT OF SALES	AMOUNT	PER CENT OF SALES
Total Sales	$57,603	100.0%	$64,102	100.0%
Production Costs	43,974	76.3%	54,281	84.7%
Gross Profit	$13,629	23.7%	$ 9,821	15.3%
Overhead Costs	2,462	4.3%	3,781	5.9%
Net Profit	$11,167	19.4%	$ 6,040	9.4%

account of rising costs of materials, labor, tools, and operating supplies, the owner simply did not get high enough prices for his services in 1953 to maintain his margin of profit. His use of more hired labor in 1953 — $12,540 as compared to $9,220 in 1952 — should have given him more time to do effective selling, and to get the more profitable class of jobs in his territory.

Overhead costs of this business also increased from 4.3 per cent of sales in 1952 to 5.9 per cent in 1953. Although the 1953 overhead is reasonable, some costs might have been reduced. Interest paid in 1953 was $368 as compared to $168 in 1952. Payment discounts on purchases should have offset interest costs in both years. Assuming a 2 per cent discount on purchases, the earned discount on purchases of $33,126 in 1952 ought to have been $662, and on purchases of $36,765 in 1953 it ought to have been $735.

This driller pays his dues to support the well driller's association but apparently did not attend the monthly or annual meetings in 1953 since no travel expense was recorded that year. Perhaps this expense was overlooked. If so, it cost at least $25 extra in income tax for every $100 of expense that was left off the books.

Now let's see what the assets and liabilities statement or balance sheet Table III) shows about this business. Accounts receivable total $12,476. This amount is about 20 per cent of the 1953 sales — a reasonable figure provided the accounts are not overdue. However, a detailed check of accounts in this case revealed that $7,800 of the total has been due for three months or more. This undesirable situation can develop from two causes. Extending credit to poor risks is one. Delaying collection is the other.

Often collections are delayed because some little detail of a job isn't completed — a minor adjustment, connection or part left unfinished. Failing to finish up a job is a serious error. Experience has shown over and over again that when a job isn't completed in a clean-cut fashion, collection problems are the immediate result.

Another important point to analyze is the investment in fixed assets — land, buildings, equipment, tools, and the like. Does it balance with the size of the business? Too much money tied up in these items often leaves too little for working capital. Depreciation costs, taxes, and maintenance go up with investment. On the other hand, poor facilities and poor equipment result in high operating costs. Deciding upon the right investment in these items requires good judgment. Good cost records help in judging correctly.

Other Revealing Figures

In addition to getting at the condition of your business by analyzing the profit and loss statements and balance sheet, your books also reveal other facts. I have noticed that some well drillers spread their buying among too many sources of supply. While it is true that bargains are offered here and there from time to time, I feel that purchasing should be concentrated and limited to a few suppliers. In some cases, you can qualify for bonus discounts based on total purchases in a year. In all cases, you will develop goodwill, for any supplier takes good care of his preferred customers.

Handling, storage and control of materials can easily shift your profit margin by 10 per cent. I have seen inventory accounts that have had to be adjusted by as much as $4,500 at the end of a year. This means that this much extra material was used and not accounted for, or that some items were left on the job, or that material was lost by theft.

Analysis of purchases also frequently discloses that credit memos covering materials returned to a manufacturer or a jobber have not been issued. These credits mean money. They are not intentionally overlooked, but sometimes receipts for returned materials are mislaid.

After adequate cost data have been kept for two or three years, it is possible to draw some general conclusions on the proper ratio of price to cost of materials or ratio of price to costs of materials and labor.

I have noticed some general relationships of this kind from the book records of a group of well drillers in the Middle West. The same factors will not fit every

TABLE III

ASSETS AND LIABILITIES STATEMENT, DECEMBER 31, 1953

CURRENT ASSETS		
Cash on hand	$ 126.00	
Cash in bank	2,864.00	
Accounts receivable	12,476.00	
Inventory	3,528.00	
CURRENT ASSETS		$18,994.00
FIXED ASSETS		
Machinery and equipment	$15,150.00	
Trucks	4,600.00	
Office fixtures	250.00	
	$20,000.00	
Less reserve for depreciation	9,675.00	
FIXED ASSETS		$10,325.00
TOTAL ASSETS		$29,319.00
CURRENT LIABILITIES		
Trade accounts payable	$ 9,456.00	
Bank loan	2,500.00	
Chattel mortgage loan	4,500.00	
Accrued payroll taxes	394.00	
TOTAL CURRENT LIABILITIES		$16,850.00
CAPITAL AND EARNED SURPLUS (Present Worth)		$12,469.00
TOTAL CURRENT LIABILITIES AND EARNED SURPLUS		$29,319.00

locality or class of drilling, but the facts revealed by the accounts I have examined will show how your cost records can serve you.

These drillers operated on productive drilling jobs an average of 40 weeks per year. The other 12 weeks are consumed in vacation, breakdowns, bad weather, delays and making repairs. These things have to be done, but they don't produce income directly. Therefore, in estimating overhead cost on a job the driller must allocate a year's overhead to a 40-week work period.

The selling price of their average well must be at least double the cost of material used on the average well in order to give their drillers a reasonable profit. Obviously, this ratio varies from job to job, but it averages out over a year. As a rough check when bidding a job, they figure their material cost and double it.

The drillers in this area find that it is reasonable to depreciate trucks, cars and tools over a five-year period; shop equipment, such as welders and compressors over an eight-year period; and drilling machines over a ten-year period. (These contractors have from $12,000 to $15,000 invested in equipment for each drilling crew they employ.)

When working by the hour or day with a drilling machine, truck and two men, the hourly rate must be $8.00 to $10.00 per hour, minimum, to make a fair profit. Time must be counted to include travel time to the job and return. Hourly costs vary with the size of drill, type of truck and special tools required for the job so prices must be adjusted accordingly.

Your book records shouldn't keep you guessing. They should give you the facts you need.

Summary

Bookkeeping records are not a necessary evil which should be relegated to the back porch of a business. They should be set up so that they are a running record of the business, showing all needed details in as simple a structure as possible. And then they should be used to the fullest possible extent. Such a business rarely goes off the track, and it is much more likely to survive difficult periods.

The bookkeeping system should be set up by a competent accountant working closely with the owner, using the simplest possible form. It should be analyzed regularly by the owner (or manager), with the aid and advice of the accountant when needed.

TOM'S COLUMN

(*Continued from Page 7*)

an' what we had found, including our recommendation fer th' gravel. We told 'em we'd use any gravel they told us to use but couldn't guarantee th' results. There was no arguments about it.

To cut the story short, we put in th' local gravel, an' pulled back th' 24-inch casing about 22 feet. We pulled back th' 12-inch line as we placed our pack. Then we pulled it all out leaving th' screen with a 10-inch extension on top. We surged an' bailed th' well just enough to clean it, put in th' test pump, an' got 500 gpm with 17 foot o' drawdown. It cleared up fast to the eye, but there was some fine sand coming. After three days o' pumpin' it still was pumpin' sand — not much but too much, anyway — maybe a teaspoon in 10 gallons.

We talked it over with th' boss again, an' he wanted us to go after th' development harder. Now, I never like to do that on this kind of a well because I think you're running a lot more chance of trouble than benefit. But after all, th' job wasn't acceptable this way, so if that's what he wanted, that's what we'd do. We surged real heavy an' bailed out a good bit of sand — so much that we got some settlement outside our 24-inch. We put in about two or three more yards o' gravel, as I remember, an' then we put th' pump back in.

It wasn't as bad as I was afraid of, but it wasn't good, either. Pumped about th' same amount o' sand an' it was just a mite cloudy. After five days of this, we had a general get-together which ended up by them tellin' us to go ahead an' do what we figgered would be best to fix it up — time an' material basis.

What bothered us most was th' settlement outside and th' water showin' up a little cloudy. No doubt, some of th' clay mixed with th' sand above the top of the screen was comin' through.

First thing we did was order some packing gravel of th' right size. We sent back home fer a line of 20-inch O.D. casing to run inside th' 24-inch. We got some Aquagel to give us a heavy mud mix. When th' gravel came we fed some in between th' 10-inch pipe above th' screens and th' 24-inch with a good stream o' clear water from our pumps to keep th' head up on th' well. Then we pulled th' screen, using a sand-lock. Th' gravel settled as we came up; so there couldn't of been much movement of the sand formation itself.

When we got th' screen out we cut off th' bottom 5 feet an' welded th' bail plug back on th' bottom of th' rest of th' screen. Then we re-drilled our hole th' full-size of th' 24-inch casing through th' gravel, an' held it open as we set our line o' 20-inch casin' which centered itself in our drill hole. Then we re-set th' screen with its extension pipe, centered in th' 20-inch. We put in th' gravel an' pulled back just two or three foot at a time an' cleared out th' mud an' developed th' pack until we had th' screen all exposed an' developed.

We ran a test on it an' came up with a 24 foot drawdown at the end o' 10 hours pumpin' at 500 gpm. Th' water was clear as crystal an' no sand. Looks like setting th' top o' screen five feet lower down blocked off th' cloudy water. It wasn't as good a well as we would of had if we could of used th' whole screen, but we were all mighty glad to settle for it. It took plenty of luck to come out of it so good without any hitches.

There are some things in this story that I think are worth pointing out. Here's some of them:

First, gravel-packing a well ain't jest dumping a mess o' nice lookin' gravel around any sort of a screen. Th' gravel has got to be fitted to th' sand so it is really acting as th' screen fer th' formation itself — th' size of openings in th' gravel have got to fit th' sand. Then th' screen has got to fit th' gravel, so th' job can be developed right.

Second, you don't cure a sand-pumper by jest working down more gravel around th' screen if th' gravel is too coarse to fit th' sand.

Third, in most cases, you lose a lot more by cuttin' down th' length of th' screen than you do by cutting down th' diameter.

Fourth, don't guarantee th' results of a job done th' way somebody else wants it done if you don't think it's th' right way.

Fifth, developin' this kind of a well is best done easy an' gradual — not fast an' hard.

Yer ol' friend,

Tom

ASSOCIATION NEWS

This section is devoted to the exclusive use of water well drillers' associations, both state and local. Notices, announcements, changes of officers and other items should be sent to The Editor, Johnson National Drillers' Journal, 2304 Long Ave., St. Paul 14, Minnesota.

New York

The summer meeting of the Empire State Water Well Drillers Association took place near Albany on July 24. The big clambake prepared for this meeting attracted a good crowd of members and their families.

W. Gordon Goold of Chatham Center handled the arrangements. The affair was a huge success.

South Dakota

A regional meeting of the South Dakota Well Drillers Association was held in the Black Hills at Sturgis on July 3. H. F. Draine, vice-president, had charge of the affair.

Another regional meeting was held on August 1, at Ruskin Park, north of Mitchell. These regional meetings promote increased interest in the Association and provide opportunities for social gatherings for drillers and their families.

Ohio

A successful meeting of the Ohio Association took place in Columbus on June 12. President George Applegate presided. Informative talks on group life insurance, liability and property damage insurance, proposals for a new constitution and well drilling codes provided an excellent program for the crowd attending.

Bob Saltzgaber reported on proposed state legislation that would set up a well drilling code and license requirements for drilling contractors. The proposed rules would be administered by the Water Resources Board. Well drillers would be included in the membership of the Board to represent the industry.

The group presented an engraved gold watch to Ed Allen in appreciation of his 15 years of service to the Association as secretary. Following a decision to hold an annual convention in 1955, Mr. Allen was named chairman of a committee to arrange the event.

The next regular meeting of the Association is set for August 21 in Columbus.

Iowa

The 25th annual convention of the Iowa Well Drillers Association on May 28 and 29 at Des Moines, was both educational and socially enjoyable. Attendance was cut somewhat by having the meeting later in the year than usual.

Two industrial films, a talk on farm water systems and a talk on geology were given on May 28. A buffet supper and square dancing made up the evening entertainment.

On May 29, Mr. E. W. Bennison presented an illustrated talk on his experiences in India during a four-month tour of duty with the Foreign Operations Administration as technical advisor on well design and construction. A business meeting and the annual banquet in the evening closed the meeting.

F. S. McCutcheon of Des Moines was re-elected president for the coming year; Andy Verwers of Sully was elected vice-president; and Travis Parker of West Branch was re-elected secretary-treasurer.

Indiana

Officers and directors of the Indiana Well Drilling Contractors Association, and their wives, met at Wabash early in

June to start plans for the Association's 1955 convention. Next year's meeting will be on February 23 and 24 at the Hotel Severin in Indianapolis. W. L. Gordon of Churubusco is president; R. T. Hill of La Fontaine is secretary.

California

The sixth annual convention of the Associated Drilling Contractors will be held September 24 and 25 at the Hotel Casa del Rey on the beach in Santa Cruz. The ADC extends a cordial invitation to all California well drillers. A fine time is assured.

Idaho

The Idaho Drillers Association held its annual meeting at the Shore Lodge at McCall, Idaho, on June 28, 29 and 30. A comprehensive schedule insured interesting and instructive sessions for everybody. Subjects discussed were Ground Water Activity of the Bureau of Reclamation, welding problems, submergible motors and sanitary protection of water wells.

One of the most important, from the standpoint of the well driller, was the panel discussion, "Drilling Costs Analysis," in which a number of prominent drillers gave their viewpoints and methods used in trying to control their costs. This particular subject has a great deal of bearing on whether the individual in business today makes a go of it, and — although it may seem dull and involved to some — it is actually one of the main factors in determining your business success.

Present officers of the Association were re-elected. Howard F. Andrew of Idaho Falls is president; W. B. Bowler of Boise is secretary-treasurer.

In addition to the drillers program, a program was planned for the women. This included a tour of local points of interest and a number of sports events.

All in all, it was a convention that was well worth attending — even without the beautiful scenery, which was thrown in free.

Virginia

The next regular meeting of the Virginia Association will be held in Richmond on September 18. Except for the election of three directors to take office on October 1, the details of the program are not worked out. Further information can be obtained from C. R. Sundquist of Norfolk, secretary of the Association.

Montana

An interesting and well-attended convention was held by the Montana Water Well Drillers Association in Billings on April 5 and 6.

Legislation designed to control the use, development and conservation of ground water in Montana was discussed at length. The state engineer's office is proposing a bill that would regulate both ground-water rights and proper well construction.

The members present adopted a resolution approving the proposal that has

A 3-inch well, 383 feet deep, being drilled for a large farm in Alabama by B. F. Johnson of Bascom, Florida. Mr. Johnson has been drilling for 36 years.

been worked out. A committee was appointed to work with the state engineer in getting the bill through the legislature.

Carl F. Hollensteiner of Dillon was elected president for the coming year. Walter Riddock of Helena was elected vice-president; Bert Van Dyken of Bozeman was re-elected secretary-treasurer.

The board of directors now includes Henry Kray of Hardin, Ira C. Bond of Terry, Ray D. Pierce of Bridger, and R. C. Simpson of Malta.

Miles City was tentatively chosen as the site of the next convention scheduled for April, 1955.

Kansas

The Kansas Water Well Drillers' Association has set October 29 and 30 as the time for its annual convention to be held at Emporia. Details of the program are being worked out. Inquiries about the meeting should be sent to J. M. Jewett, Service Secretary, Lawrence.

Oklahoma

The 1954 convention of the Oklahoma Drillers Association will be held at Enid, Oklahoma. The officers and committee are working hard to make this the best meeting the Association has had. Many equipment displays are expected.

A real old-fashioned barbecue and a ladies' luncheon and style show are among the entertainment events being planned.

Mississippi

The southwest section of the Mississippi Water Well Contractors' Association had a well-attended meeting in June. President Fred Sutter has asked the directors to call similar sectional meetings this summer to discuss plans for the annual meeting later.

The time and place of the 1954 annual meeting have not been determined, but a committee is making contacts in several cities. If possible, a location in the northeast or east central section of the state will be chosen.

NWWA Exposition

From September 28 to October 1, Minneapolis will play host to the NWWA Exposition. The meeting will headquarter at the Hotel Nicollet, assuring good accommodations for all. Indoor exhibits will be in the main ballroom of the hotel. Space for outdoor exhibits has been provided two blocks away, in Pioneer Square, where a number of well drilling machines and other types of water-well equipment will be displayed and operated.

The organized meetings will be held in the morning of each day. A good program of speakers will talk on a wide range of subjects. Afternoons will be left free for inspection of exhibits. Main social events will include a get-acquainted party, a Paul Bunyan party and the banquet on Friday evening.

A large crowd of drillers and exhibitors is expected.

A Significant 50 Years

About the time Johnson Well Screens were first being made in 1904, President Theodore Roosevelt was vigorously telling the people of the United States that they must stop wasting the nation's natural resources and promote their conservation. The idea was highly unpopular at first, but over the years it has come to be a matter of primary consideration in our country's development.

President Eisenhower, in a special message to Congress last year, referred to the 50th anniversary of this conservation policy by saying, "Our basic problem is to carry forward the tradition of conservation, improvement, wise use and development of our land and water resources — a policy initiated 50 years ago under the leadership of President Theodore Roosevelt.

"To do this within the framework of a sound fiscal policy and in the light of defense needs will require the maximum cooperation among the States and local communities, farmers, businessmen, other private citizens and the Federal government. It will require the development of clear guidelines by the Congress as to the proper functions of the Federal government.

"Conserving and improving our land and water resources is high priority business for all of us. . . . We must build a balanced program for the use and development of all our natural resources. . . . "

In 1904, the founder of Edward E. Johnson, Inc., was among those who fully supported Theodore Roosevelt's principles for conserving the nation's ground water resources. During the 50 years of its existence the company has taken a clear stand for the conservation of ground water through:

1. Intelligent development for beneficial use.
2. Sound methods of increasing recharge to aquifers.
3. Measures to prevent pollution.
4. Eliminating practices that waste ground water.

In celebrating its 50th Anniversary this year, the Edward E. Johnson organization takes pride in having identified itself with these principles. We salute, on its 50th birthday, the nation's vital policy of land and water conservation.

Address, Please!

The Johnson National Drillers' Journal appreciates notices of change of address. If you move, please send in both your new and your old address. If your copy of the *Journal* is incorrectly addressed, please tell us.

The late George Lamphere drilling well at Pottersville, Michigan, in 1914. The well shown here is still in use. Mr. Lamphere drilled wells for 50 years until his death in 1946. Johnson Well Screens were ten years old when this picture was taken.

ADVERTISEMENTS

We will insert advertisements for drilling equipment wanted or for sale, help or work wanted, etc., for our readers, free of charge. Advertisements must be brief, and we cannot assume responsibility for them, but will be glad to put parties in touch with each other by this means and suggest that they investigate any offers or inquiries carefully for themselves.

WANTED: Bucyrus-Erie 22W drilling machine; truck mounted, trailer mounted or unmounted. Also slim-hole rotary drill for 1,000 to 1,500-foot work, complete with tools. Adolph Rude, Flandreau, South Dakota.

FOR SALE: Solid derrick for Bucyrus-Erie 20-W. 32′ long, with all sheaves and rubber mounting. Martell Bros., Somerset, Wisconsin.

FOR SALE: Star #240 drilling machine; string of tools for 4-inch work and string for 5 and 6-inch work; complete, with wrenches and jacks. Price, $3,000. Perkins Well Drilling, 1017 Summit Avenue, St. Paul Park, Minnesota. Phone: La Salle 2608.

FOR SALE: Dempster No. 15 cable tool with IHC 6-cylinder motor mounted on two-ton White truck; 30-foot wood mast; for 1,000-foot work, set of jars; 4″, 5″ and 7″ bits; 4″ 12′ bailer; ½″ drill line and ⅜″ sand line. Excellent condition. Price $1,500. D. E. Stupka, Stratton, Nebraska.

FOR SALE: Ideco drilling machine, mounted on Mack truck. Price, with tools, $5,000. Henry Merry, Franklin Street, Duxbury, Massachusetts.

FOR SALE: 1951 Ideco #10 drilling machine, mounted on 1941 Dodge cab-over-engine truck, with 2-speed axle. Excellent condition. Telescoping derrick with power lift; cat-heads; electric starter; built-in tool box. Also 800′ of nearly new ⅝″ drill line and 700′ of sand line. Andy Verwers, Lynnville, Iowa.

FOR SALE: Keystone #70 drilling machine, mounted on 1942 truck. 1,000′ of ⅞″ drill cable; 4″ and 6″ tools; set of jars; wrenches; drive clamps. Price, $1,800. Joseph E. Ellis, Route 2, Box 252C, Orlando, Florida. Phone: 39543.

WANTED: Power well auger, with engine drive. State price and condition first letter. Julius Ford, 633 W. Chase Street, Macomb, Illinois.

FOR SALE: Keystone, all-steel, extension-mast spudder, mounted on 1948 International truck; with heavy-duty power winch. Machine completely overhauled 1953. With or without tools, for 4″ to 10″ wells. Charles Appleby, 192 Liberty Street, Warsaw, New York. Phone: 118-R.

W. A. Vanderhoof of Waverly, New York, drilling his own well for water supply for his new garage and warehouse.

FOR SALE: Good as new, 1946 Model Bucyrus-Erie 22-W spudder on 1937 D.S. 30 I.H.C. truck; 36′ derrick with power hoist, casing reel, catheads, spooling device, slack-line holder. Four-cylinder Buda H.P. 217 engine. Drilling, fishing and casing tools for 6″ to 18″ wells. Due to ill health will sell complete at bargain price, $6,500. Write for list of tools. L. F. Bales, 704 N. Broadway, Sayre, Oklahoma, phone 867.

FOR SALE: No. 35 Armstrong drill on semi-trailer with International truck; tools and cable; price $1,000. Leonard Shilhanek, Tama, Iowa.

FOR SALE: No. 24 Bucyrus-Erie drilling machine mounted on truck; in very good condition. Priced to sell. Hoeg and Ames, Lincoln, Iowa.

POSITION WANTED: Young energetic, highly experienced well drilling engineer and assistant want drilling work outside India. Wish to improve experience with a good firm. Sober habits. Salary open. Employed now as executive engineer and assistant, Tube Well Boring Department, Ahmedabad, India. Have 17 years' experience in use of percussion, core, jet and rotary drills for water and oil wells. Write Errol A. Gore, c/o Edward E. Johnson, Inc., 2304 Long Ave., St. Paul 14, Minnesota.

WANTED: Will buy or rent rotary drilling machine, truck mounted, complete with drill pipe. Capable of drilling 6″ hole to 500 feet. D. E. Stupka, Stratton, Nebraska.

FOR SALE: Cook double-acting 8″ pump, 18″ stroke, 100-foot setting. Size 2-L, 15 HP, 1160 rpm, 440 V. A-1 condition. Polar Ice Company, Decatur, Illinois.

WANT TO TRADE: 1954 modern Richardson house trailer for 20-W Bucyrus-Erie or comparable drilling machine. Dee Linn, Morganton, Arkansas.

FOR SALE: Two number 10-W Ideco drills, mounted on trucks; set of 4″ and 5″ tools with each machine. Price, $3,500 each. John Hufker, 8831 W. 95th Street, Oak Lawn, Illinois. Phone: Garden 4-1625.

WANTED: Used drill collars for Failing 1500 drill. Give size, length, and price, first letter. Sydney Earl, Kerrwood, Ontario, Canada.

FOR SALE: Rotary drilling machine, with 17¼ rotary, Emsco 100-tone swivel, 55-foot 100-ton telescoping derrick. Portable, for quick moving and set-up. Complete with tools, pipe and lighting plant. Garner-Denver 7¼ x 10 mud pump with 180 HP Climax engine, mounted and carried on 10-ton, 10-wheel truck. Can be purchased with or without pipe and truck. Will trade or rent. American Drilling Company, 674 Branch Avenue, Little Silver, New Jersey.

WANTED: Star #71 drilling machine, with calf reel. Complete with tools. Would like to purchase from person west of Minnesota. R. Gordon Downey, Box 142, Duncan, B. C., Canada.

FOR SALE: Mobile dry-hole auger. Capacity: 5″ hole to 100.′ Will trade for larger rotary or cable tool drill. Elmer Crain, Boyne City, Michigan.

WANTED: Failing 1500 or similar drilling machine. Also, Bucyrus-Erie 20W or similar cable tool drill. Elmer Crain, Boyne City, Michigan.

WANTED: Bucyrus-Erie 20, 21W or Ideco drilling machine. Give condition and price first letter. O. E. Lewis, Darlington, Indiana.

FOR SALE: Bucyrus-Erie 22W drill, truck mounted, in good condition. Price, $4,000. No. 35, all-steel, Armstrong machine, trailer mounted. Practically new International Engine. Price, $1,000. Bonnicksen & Son, Ringsted, Iowa.

POSITION WANTED: Wish opportunity to learn well drilling business, particularly rotary drilling. Prefer to work in Illinois or Indiana. R. A. Martinkus, 5177 W. 64th Place, Chicago 38, Illinois. Phone PO-7-1146.

WANT TO BUY: Used rotary drilling machine in good condition, less truck. Prefer ELI M-7 drill, or similar type, with extra large mud pump. Require drill pipe and tools with machine. Send complete details to Box POB, c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 14, Minnesota.

FOR SALE: Howell No. 60 drilling machine mounted on semi-trailer. Has 28′ derrick; cable included but no tools. Priced to sell. Ervin Halvorson, Rake, Iowa.

FOR SALE: No. 50 Keystone drilling machine with 38′ derrick, tool guide, cable holder, Buda engine, power derrick raiser and oil shock absorber in top of derrick head; mounted on White truck. All in good condition. Tools for 5″, 6¼″, 8″ and 10″ holes. Selling in order to retire. E. C. Rudert, Box 32, Saxonburg, Pennsylvania.

FOR SALE: Two nearly new Stone's model 31 drills mounted on good Chevrolet trucks; 33-W Bucyrus on 1947 Dodge. Tools up to 6″ diameter; dies and cutters; Lincoln 185-amp welder; cutting torches. Will sell any part separately; all priced cheap. Paul Duke, 1339 Monroe Street, Fort Myers, Florida. Phone: 55191.

FOR SALE: Bucyrus-Erie 22W drill, new in 1953, complete with all extras; mounted on 2-ton 1950 Chevrolet truck, with new 1953 motor. Drilling, fishing and casing tools, bit forge, water pump, tanks, welding outfit and many miscellaneous items. About 400 ft. casing. Also lease on shallow oil in good standing, ⅛ royalties. Price, $12,000. C. M. Conway, P. O. Box 34, Blanding, Utah.

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FOR SALE: No. 240 Speed Star drilling machine, three years old, in good condition, mounted on 1941 Dodge truck. New motor. Complete string of tools for 6" wells; 500 ft. of drilling cable; 500 ft. sand line. Ready to start drilling. Price, $2,850. Joe Warren, Subiaco, Arkansas. Phone: 2261.

FOR SALE: Austin drilling machine, mounted on four-wheel trailer, complete with all tools, ready to go to work. W. J. Sebesta, Route 2, Cadott, Wisconsin. (Eight miles north of Cadott on Hwy. 27.)

FOR SALE: No. 71 Speed Star drill, new in 1947, mounted on trailer with good tires. No. 240 Speed Star machine, older model but in operating condition. Numerous tools and accessories. Studebaker 1½-ton truck, 1948 model. Wilson welding machine, new in 1949; used very little. Mrs. H. H. Francis, Box 251, Twin Falls, Idaho. Phone 897 after 6 P. M.

FOR SALE: Good used well drilling machine with tools to drill in rock. Frank Pytel, Highway #1, Monmouth Junction, New Jersey.

FOR SALE: Howell #60 trailer-mounted drill with 1942 Chevrolet tractor; 300' drill cable and sand line. All in nice shape. Price, $1,300. Oscar Nygard, Meadowlands, Minnesota.

FOR SALE: LeRoi air compressor on 3 axle GMC, ex-Army machine, 105 cfm. Fine piece of equipment at a bargain. Also 160 H.P. Continental marine engine, unused. Write: Box ADC, c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 14, Minnesota.

FOR SALE: Turbine pumps. Deming 7½ H.P., 6" bowls; 50 gpm at 300' TDH; 200' of column, water lubricated. Peerless 20 H.P. new Moturbo head 1800 rpm, 3 phase, 60 cycle, 220 volts. Two sets 12" bowls, 1000 gpm at 90" head, unused. One set 8" bowls, 250 gpm at 315' head. Price, 50 per cent new cost. Write: Box ADC, c/o Edward E. Johnson, Inc., 2304 Long Avenue, St. Paul 14, Minnesota.

FOR SALE: No. 71 Star with Continental motor, rubber shocks, derrick in good shape; mounted on heavy International truck; runways each side for carrying tools. Price, $3,500. Gray Well Drilling Company, Box 181, Delafield, Wisconsin.

FOR SALE: Bucyrus-Erie 24W with calf reel, cat heads, LeRoi motor; mounted on 6x6 Studebaker army truck. Approximately 400' of ¾" cable, 750 ft. ⅜" sand line and calf-wheel line. Bits, bailers, tools, extra any size. Price, $5,500. Gray Well Drilling Company, Box 181, Delafield, Wisconsin.

FOR SALE: Stardrill Keystone #22K, new in 1953; 36' mast, power derrick raiser, calf reel, catheads; mounted on 1947 International truck; all in good condition. Price, $5,000 with tools and cable, $4,000 without tools and cable. Preston S. Maskell, Box 68, Waterboro, Maine.

FOR SALE: New 1951 Keystone combination blast hole outfit, slightly used, with tools. Now mounted on 5-ton Autocar truck. Price, $6,500. Henry W. Merry, Duxbury, Massachusetts.

FOR SALE BY OWNER: One 6 stage Smithway water lubricated deep well turbine, complete with right angle gear drive for 500 gpm 225' total head, 1,760 rpm 70 feet 6" x 1¼" column, 20' suction pipe, prelubricating tank and fittings; pump brand new, never uncrated; price $1,850, immediate delivery. Box ADC, 2304 Long Avenue, St. Paul 14, Minnesota.

FOR SALE: Bucyrus-Erie 20W drill with 32 ft. derrick; on GMC truck with 2-speed rear axle; 300 ft. ⅝" cable and 400 ft. sand line. Machine is two years old, used about eight months and is just like new. Price, $3,500. Also all kinds of tools for sale. Douglas Holzem, 1975 Prairie Avenue, Beloit, Wisconsin.

A. M. Edwards of Lexington, Oregon, drilled this 8-inch well in rock formation, 132 feet deep. Casing is seated in rock at 25 feet. Being pumped at 200 gpm, the well flowed 84 gpm before testing.

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